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NASA TECH BRIEF

Filled Polymers for Bearings and Seals Used in Liquid Hydrogen

The use of fillers has resulted in reduced wear rate and improved mechanical properties (compressive modulus and shear strength) of polymers for use in liquid hydrogen. The best results were obtained with compositions containing 60% graphite and 40% nylon; 15% Al_2O_3 and 85% PTFCE (polytrifluorochloroethylene); and 15 and 25% glass fiber in PTFCE.

The relatively poor lubricating properties of liquid hydrogen require that surfaces in sliding contact in the presence of liquid hydrogen be self-lubricating. The bearings and seals of liquid-hydrogen turbopumps require materials that will operate for long periods of time under severe conditions of load and speed. PTFE (polytetrafluoroethylene), as a base material, has been used with success for bearing and seal materials in liquid hydrogen. PTFE, however, tends to exhibit cold flow under pressure, and also has a large coefficient of thermal contraction. To minimize these undesirable characteristics, new material combinations were needed.

Friction and wear experiments were performed on nine selected polymers with various fillers, to determine: (1) whether the polymer materials had good lubricating properties; (2) whether they had mechanical properties better than PTFE for sliding contact in liquid hydrogen; and (3) the effect of fillers on these properties. The results of the tests were compared with a reference material, filled PTFE (80% PTFE + 15% glass fiber + 5% graphite).

Friction of most of the polymers was similar to that of the PTFE. A comparison of the physical properties of four of the PTFCE's (those filled with 15 and 25% graphite, and with 15 and 25% glass fiber) with the reference material, showed that the filled PTFCE's have higher compressive moduli (factors of 4 to 7), and lower coefficients of thermal contraction (factors from one-fourth to two-thirds).

Although the filled polymers tested did not have lower friction or wear, they all showed better thermal stability, less creep, and higher compressive moduli than filled PTFE.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
NASA-TN-D-5073 (N69-19800), Friction and Wear of Nine Selected Polymers with Various Fillers in Liquid Hydrogen

Patent status:

No patent action is contemplated by NASA.

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